April 3, 1996

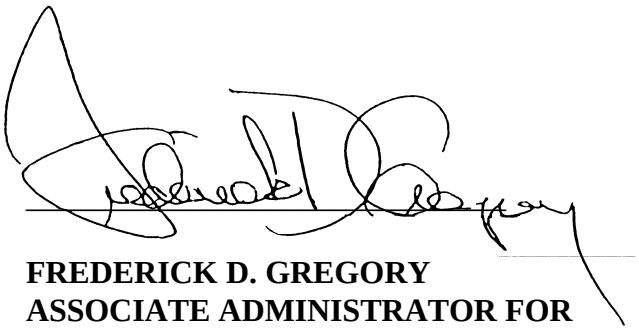
SAFETY AND MISSION ASSURANCE

FOR THE

HUMAN EXPLORATION AND

DEVELOPMENT OF SPACE (HEDS)

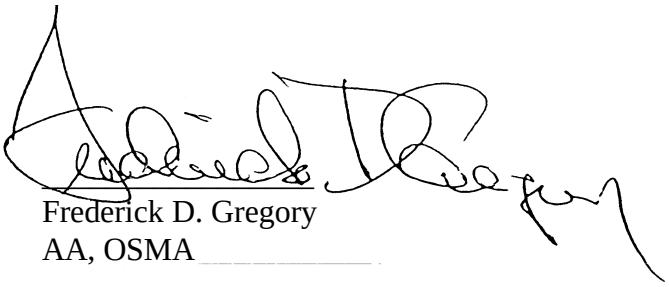
ENTERPRISE



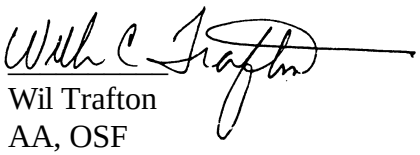
FREDERICK D. GREGORY
ASSOCIATE ADMINISTRATOR FOR
SAFETY AND MISSION ASSURANCE

ENDORSEMENTS

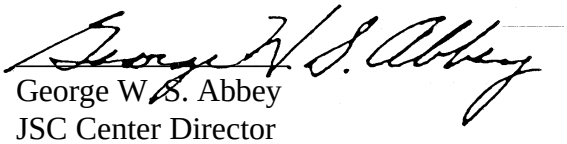
The following individuals represent organizations which agree to participate in and support the provisions of this plan for the safety and mission assurance for the Human Exploration and Development of Space Enterprise



Frederick D. Gregory
AA, OSMA



Wil Trafton
AA, OSF



George W.S. Abbey
JSC Center Director

FOREWORD

The Office of Safety and Mission Assurance has been assigned the responsibility for achieving the objectives levied by NHB 1101.3 related to oversight, independent assessment, technical review, and evaluation. The goal is to assure safety, integrity, and mission success for NASA programs.

The health and integrity of highly complex and technical NASA programs are influenced by more than just engineering capability and technical knowledge. External influences including political and media attention can result in decisions that may not be optimal in technical terms. Management may be required to take actions and approaches that are dictated by externally imposed schedules and limited funding. The need to develop close cooperation among geographically diverse Centers and International Partners further complicates the task of managing and integrating complex programs. None of the other NASA Enterprises is more complex, has higher visibility, is more costly, or is more difficult to manage than the Human Exploration and Development of Space Enterprise.

Experienced management judgment is critical to all phases of the research and development process, and in the operation of human space exploration programs. The validity of this judgment is affected by the management approach, level of training, experience with similar tasks, and, to a large extent, the inherent pressures of schedule and budget limitations. Independent review and oversight are used to verify the integrity of ongoing enterprises. This is particularly important in a time of transition to new management concepts and organizations.

The implementation of independent review and oversight of the HEDS does not reflect on the competence, motivations, or integrity of NASA management or its contractors, engineering, operations, flight crew, or program or project organizations or personnel.

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION

1.1 PURPOSE

This plan defines and establishes the organization, processes, and practices by which the Office of Safety and Mission Assurance (OSMA) will implement its responsibility for top level independent review, oversight, and evaluation of the Human Exploration and Development of Space (HEDS) Enterprise.

1.2 OBJECTIVES

The overall program assurance activity for the Enterprise will focus on the health, capability, and implementation of an effective safety and mission assurance (S&MA) program (which includes safety, reliability, availability, maintainability, quality assurance, and risk management) for the Enterprise and its subordinate programs and projects. OSMA will obtain insight of the Enterprise at the highest level, assessing whether the Enterprise is achieving its objectives. It is expected that the Center S&MA and Engineering organizations will provide the lower level technical insight and independent assessments, i.e., the "daily drills" of the programs and projects.

1.3 ASSUMPTIONS

These criteria have gone into the development of this approach for the overall HEDS S&MA function:

I. The approach preserves to the greatest extent possible the existing structure, functional relationships, and resource constraints now in place within the HEDS Enterprise, including the cognizant Centers.

II The approach supports the ability for the S&MA community to perform independent assessment of programmatic and engineering decisions to assure that proper attention is paid to risk.

III. The approach supports the integration of Shuttle, Station, Payloads, and the eventual merging of Shuttle and Station program management. It addresses Station element safety and mission assurance as an integrated hardware/software element, as a Shuttle payload, and in its on-orbit operations with and without Shuttle tending.

IV. The structure provides added confidence that Center S&MA organizations are working effectively with proper focus, documented procedures, adequate resources, and established performance based metrics.

1.4 APPROACH

A newly formed board, " The HEDS Assurance Board," will provide senior NASA management with timely, objective, non-advocacy assessments of program health, status, and relative safety posture of the HEDS Enterprise. It will identify deficiencies, and make recommendations for correction. **The HEDS Assurance Board will remain in place only during the management transitions now underway.** The HEDS Assurance Board will (1) assess the work processes and overall effectiveness of the entire S&MA community, (2) review HEDS programs to ensure that proper attention is being paid to risk and (3) review the overall effectiveness of the hardware, software, and operational aspects of the program to assure its Safety and Mission integrity. It will place special emphasis on assessing the performance of program S&MA against the Shuttle Restructuring Mission Assurance Plan, its ability to achieve "insight," its utilization of scarce resources (including DCMC), its ability to certify contractor processes to be stable and capable, and its ability to function effectively under the Administrator's new management strategy and guidance.

1.5 SCOPE

The HEDS Assurance Board will assess all aspects of the HEDS. It will provide an ongoing assessment of the safety and risk management for the Enterprise as a whole and each major program. This multi disciplinary examination of the Enterprise recognizes the need to look at interrelationships between schedule, budget, technical complexity, human resource deployment and skill readiness, requirements definition, and design, manufacturing, operations issues, and successful space flight.

The HEDS Assurance Board will provide a venue for consideration of specific programmatic risk issues which have not been satisfactorily resolved within the program

1.6 PRINCIPLES OF OPERATION

In order to perform the Safety and Mission Assurance (S&MA) function for the HEDS Enterprise, a set of necessary conditions has been established:

1. Trust and Respect among the S&MA offices, the Centers, and the Enterprises.

    a. S&MA serves in a position of trust as the *"Safety Conscience of the Agency"*--to question the safety of all that NASA and its contractors do, even when others would be reluctant.

b. Trust and respect is such that Centers and Enterprises seek out *early S&MA involvement* (partnership) in programs/projects to help reduce the cost of mission success, foster an efficient process, and manage risk.

c. S&MA earns and enhances the trust and respect of others through its *vigilance--to* detect adverse trends and incipient problems with sufficient lead-time to avert catastrophe (this is especially important in these times of change and reduced personnel).

2. Clear and direct lines of authority/required compliance with basic policy.

a. Program/project managers understand that *they are responsible* for the safety and mission success of their programs/projects; and that S&MA will assist in the planning, implementation, insight, oversight, and independent assessment thereof.

b. S&MA is *independent* from the program in the assessment of safety and other elements of mission success, including reliability, maintainability, and quality. It provides the NASA Administrator and Program Manager an independent assessment of readiness prior to proceeding at critical program milestones.

c. Center S&MA directors have the *absolute authority to stop activities* which are deemed by them to be unsafe. Program leadership must be willing to halt and review their activities when an unassessed risk to safety is identified.

d. S&MA serves as Agency policy maker in the area of human flight safety and occupational safety to ensure compliance with regulatory requirements.

3. Equitable allocation of resources to the S&MA offices.

The stability of the S&MA workforce (including existing support contractors) must be assured, including possible provision of increased staffing in areas where the need is safety-critical.

4. Code Q's proactive functional leadership of the Enterprise S&MA activity.

Code Q performs Enterprise-unique assessments of the effectiveness of the processes supporting safety and mission success within the respective Enterprises, including Lead Centers, associated programs and projects, and supporting Centers. Performance-based standards are developed jointly with the Enterprise and the Center S&MA Directors for each year's operation. Assessments of performance against such metrics are presented formally and periodically to the HEDS.

5. Clear and open communications.

   a. S&MA serves as a *communications conduit* for safety and mission assurance problems and concerns when other conduits fail to communicate, including communicating the concerns of individuals who might otherwise be reluctant to speak out. The NASA Safety Reporting System (NSRS) program is maintained as a path of last resort which provides for confidential communication of safety problems from anywhere in NASA and its contractor community.

   b. A rigorous, disciplined S&MA technical assessment process is in place and maintained wherein issues of concern are dealt with openly and on their technical merits.

   c. Center S&MA Directors retain direct access to their Center Directors; likewise, the AA OSMA retains direct access to the Administrator.

   d. Center S&MA Directors and the AA OSMA do not hesitate to communicate with one another directly and expediently *whenever* there is an issue of concern to either party.

   e. NASA S&MA personnel at all levels foster open communications with their contractor and International counterparts.

6. Efficient and effective information resources.

   a. The S&MA function pursues its goal of ensuring that timely, adequate, and appropriate S&MA information will be available to support decision-makers

   b. S&MA assists the HEDS Enterprise to draw upon the lessons learned from past successes and failures for application to new endeavors, simultaneously ensuring that new lessons are documented for future use.

   c. S&MA works to improve program/contractor problem reporting and data integrity (accuracy, completeness, timeliness, and security).

7. Meaningful measures and metrics.

   S&MA implements a viable metrics program for: a. Managing and assessing internal S&MA processes (audit, surveillance, and analysis); b. Assessing program/contractor processes as they relate to safety, reliability, maintainability, quality and timeliness; c. Assuring that accurate and complete records are being maintained of configuration, specification compliance, interface verification, and other critical engineering data.

8. S&MA Integration into "Team NASA "

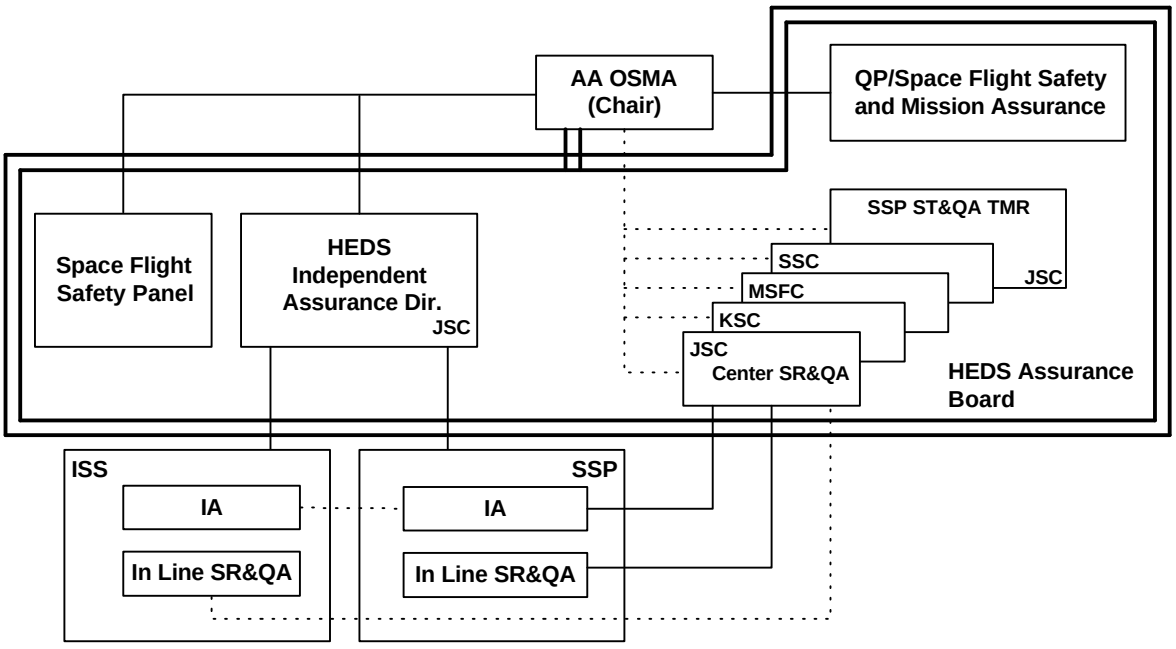
a. S&MA serves as *"Team-/NASA's" consultant* on the assessment, management (including what level of risk is acceptable), and reduction of risk through the early and continual application of safety, reliability, maintainability, and quality management and engineering technology (including defining the minimum set of requirements)

b. The S&MA function serves as *"Team NASA 's" corporate memory* to ensure that lessons learnd from failures need be learned only once

2.0 ORGANIZATION

The following figure depicts the organization structure which will assure the safety and integrity of the HEDS programs. Key to the activity is the establishment of the HEDS Assurance Board. This board, reporting to the AA OSMA, will provide the necessary input to assess the safety and mission success of processes internal to the HEDS enterprise

Safety and Mission Assurance
HEDS Enterprise



The HEDS Assurance Board function will provide its customers with credible, objective, non-advocacy reports regarding the integrity of Enterprise and program processes at any specified time. The OSMA recognizes that the new Lead Center and Space Flight Operations Contractor (SFOC) approaches being implemented for the HEDS Enterprise present many challenges to assure continued safe and successful development and operations. The concept described herein answers the challenge and provides a new dimension to the role of independent assessment, insight rather than oversight, in the support of NASA Enterprises and programs. As described below, each HEDS Assurance Board member will provide an essential element for an accurate assessment of HEDS operations. Findings will be communicated to both the AA OSF and the NASA Administrator by the AA OSMA

2 1 HEDS ASSURANCE BOARD MEMBERSHIP/ROLES

The HEDS Assurance Board will be composed of eight individuals, each providing a unique perspective. Each individual has both a day-to-day function and the periodic HEDS Assurance Board responsibility.

2.1.1 HEDS INDEPENDENT ASSURANCE DIRECTOR FOR PROGRAMS (JSC)

The HEDS Independent Assurance Director for Programs is the AA OSMA's field representative for programmatic issues. The HEDS Independent Assurance Director's safety and mission assurance perspective is gained from the independent technical assessments performed by the organization's ISS and SSP IA organizations and from those issues which flow through the **"Risk Level Screen"** (discussed in section 3.1) from the in-line S&MA activity. This position provides a major starting point for the eventual integration of the S&MA processes for Shuttle and Station and better supports Station-tended operations scenarios. In addition to the routine activities performed by the HEDS Independent Assurance Director, it is anticipated that special assessments addressing high risk issues will be chartered. Resources for these assessments will be supported by the Center S&MA Director, AA OSMA, or external agencies. Such assessments will be coordinated with OSMA.

2.1.2 CENTER S&MA DIRECTORS (JSC, KSC, MSFC, SSC)

The Directors provide resources to the HEDS programs and are responsible for the effectiveness of their Center's S&MA process on HEDS programs. Additionally, they participate in forums to discuss and resolve inter-Center S&MA issues.

2.1.3 SSP S&MA TMR (JSC)

The SSP S&MA TMR (JSC) reports to the PM, SSP. As the SSP representative interfacing with the SFOC, the TMR will assess the overall performance of the contractor S&MA operation. This

data, when combined with the Center S&MA metrics and the insight, audit, and surveillance data, will provide the basis for an assessment of the SFOC operation.

2.1.4 QP/SPACE FLIGHT SAFETY AND MISSION ASSURANCE

This Headquarters organization will verify, through spot checks and self-assessments, the suitability and effectiveness of processes used by each Center for program safety and mission assurance insight. It will continue to be the OSMA member of the SSP Mission Management Team and will retain responsibility for the generation of the flight by flight Mission Safety Evaluation

2.1.5 SPACE FLIGHT SAFETY PANEL (SFSP)

The SFSP reports to the AA OSMA. It provides for representation of flight crew personnel in the assessment of space flight safety. The panel ensures that safety issues and recommendations are (1) identified and assessed during the development and implementation of NASA space flight programs and (2) addressed in subsequent technical and management decisions

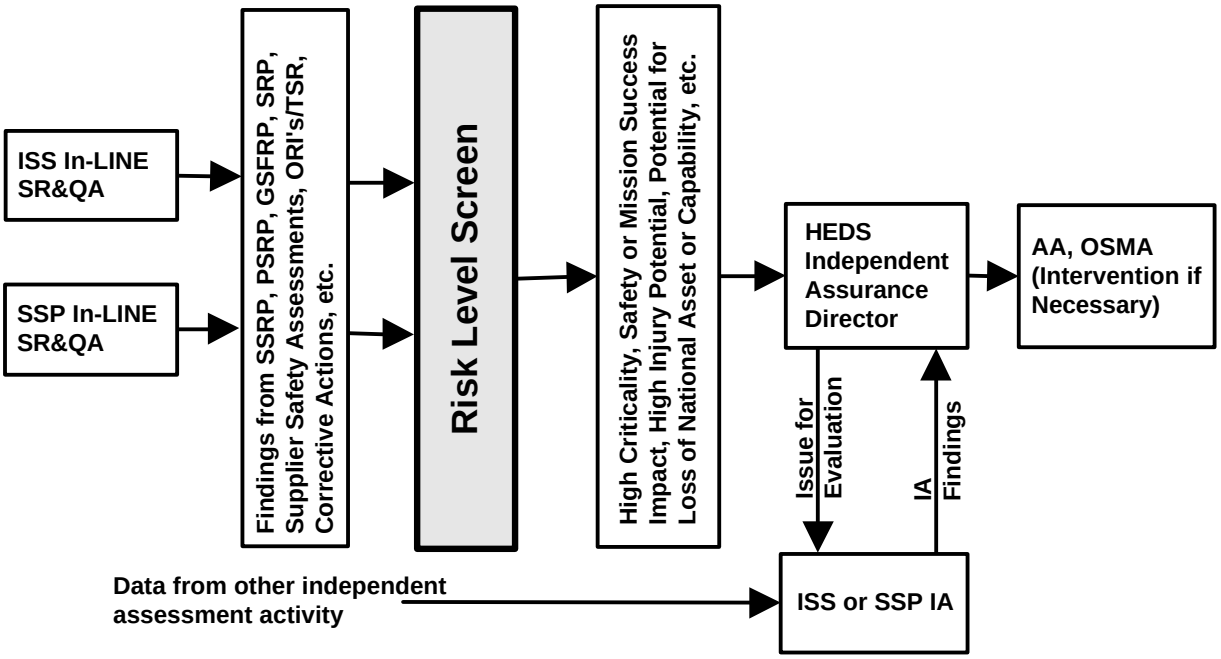
3.0 SPACE SHUTTLE AND STATION PROGRAM SAFETY AND MISSION ASSURANCE PROCESS

The following operational processes have been developed such that they do not significantly alter the existing organizational structure. The one addition is the HEDS Independent Assurance Director position with its integration role reporting to the AA OSMA. However, the processes for performing the safety and mission assurance risk screening will be made more uniform and will be better documented. Further, OSMA's functional leadership role will be strengthened and made more responsive to Center S&MA needs. These changes are reflected in two areas: (1) the establishment of a risk level screen; and (2) Center S&MA process verification.

3.1 RISK LEVEL SCREEN

The risk level screening will be a formal process. It will provide a clear, auditable process for issues uncovered during in-line S&MA evaluation to be elevated for further analysis. It is anticipated that this process will independently resolve most issues at the Center level and few will require intervention by the AA OSMA with the Lead Center Director. As illustrated, safety and mission assurance concerns uncovered during the day-to-day operation will be evaluated by the screen criteria. Most concerns will be resolved by the Center S&MA Director as is the case today. Some number, however, will pass through the screen to the HEDS Independent Assurance Director for a more detailed independent assessment and resolution with the Program Manager if necessary. By exception, the HEDS IAD may elect to reevaluate decisions closed at the Center level.

HEDS Risk Screening Process



3.2 PROCESS VERIFICATION

Much of the confidence in the overall safety and mission integrity of the HEDS Enterprise is found in the robustness of the day-to-day operations of the in-line Center S&MA processes. Accordingly, the AA OSMA will establish a process verification methodology to be implemented by QP/Space Flight Safety and Mission Assurance. This methodology will independently assess the compliance to OSMA policies and directives, effectiveness of ongoing S&MA activities, availability and quality of resources, and the robustness of the risk screening process to uncover problems that may require AA OSMA intervention

The process will begin prior to each fiscal year with the submission of a Center S&MA operating plan detailing planned products, milestones, and required resources including projected funding shortfalls. The operating plan will describe the products and metrics by which the Center S&MA organization will be judged. These metrics will clearly describe the effectiveness of their operation as related to documented procedures and the Principles of Operation described in item 1.5.

Once agreement on an effective plan is reached, the needed resources will be sought from the Center Director; failing this the AA OSMA will negotiate with the AA OSF or the Lead Center Director to secure the required funding. In those few cases where important requirements can not be adequately met with available HEDS funding, the AA OSMA may provide Q resources to cover the shortfall. Evaluation of Center performance against the operating plan will be achieved by a two part process; both parts of which currently exist but will require strengthening.

The first part of the evaluation process is the Center S&MA self-assessment which, to a large extent, is covered within the established FMR procedures. These procedures will be reviewed and improved. The FMR will become more focused and more product metric oriented. The second part will be similar to the Phase II NASA Engineering and Quality Audit with a few specific areas chosen for in-depth examination (current Safety Spot Checks perform some of this function). The purpose of such reviews will not be to find fault but to uncover areas and causal factors where S&MA processes at a given Center or across Centers are not sufficiently effective. The AA OSMA will work with the cognizant S&MA management to remove or at least ameliorate roadblocks to their effectiveness. It is recognized that an infusion of Q funds may be required. This two part process will provide an ongoing, independent evaluation of the Enterprise-wide risk management. It will address the interrelationship between schedule, budget, technical complexity, human resource availability, and skill mix.

4.O INTERNATIONAL PARTICIPATION

The HEDS Enterprise is international in nature involving NASA, NASA's international partners, and international customers. The HEDS Enterprise independent assessment function will include consideration of international elements and operations in its activities.

External to the HEDS Enterprise, the international partner senior S&MA Directors interface directly with the AA OSMA. Within the framework of the Enterprise, the international organizations interface directly with the appropriate NASA Program Manager and operate in accordance with the MOUs and Joint Management Plans. S&MA counterparts within the international organizations interface with the appropriate S&MA managers.

There currently is no identified counterpart, per se, in the international organizations to the HEDS Assurance Board. The HEDS Assurance Board will work through the HEDS program offices to interface with the international organizations when needed.

5.0 DETAILED ROLES AND RESPONSIBILITIES

The following section provides a more detailed description of the various roles and responsibilities to be performed by supporting organizations in the execution of the safety and mission assurance process.

5.1 Associate Administrator for Safety and Mission Assurance:

5.1. 1 Develops policy, requirements, standards, and guidance for S&MA for the Enterprise and serves as functional leader for Agency wide S&MA.

5.1.2 Chairs the HEDS Assurance Board and provides direct input on programmatic safety and mission integrity to the AA OSF. Additionally, assesses and provides input on Center Director performance.

5.1.3 Evaluates S&MA effectiveness for HEDS and provides input to Center Director on S&MA Director performance.

5.1.4 Negotiates with AA OSF and/or Lead Center Director to resolve resource or management issues which inhibit S&MA effectiveness.

5.1.5 Provides NASA Administrator, AA OSF, Lead Center Director, and Station and Shuttle Program Managers with an independent assessment of readiness for major test and launch activities.

5.1.6 Provides S&MA input/position to Headquarters PMC on Enterprise programs undergoing review

5.2 HEDS Independent Assurance Director for Programs

5.2.1 Manages the Space Shuttle and Station Independent Assessment function. Assigns to the SSP IA and ISS IA managers assessment tasks on those issues that have passed through the Risk Level Screen or are requested by the AA OSMA.

5.2.2 Requests AA OSMA intervention in those few cases in which action at the lower levels has proved unsatisfactory.

5.2.3 Serves on the HEDS Assurance Board to provide insight into Enterprise programmatic issues.

5.3 QP/Safety and Mission Assurance Director

5.3.1 Provides mission readiness support to the AA OSMA through the development of the Mission Safety Evaluation and participation in the Preflight Assessment Review (PAR) process. Serves as the OSMA member of the Shuttle Mission Management Team for Prelaunch activities.

5.3.2 Establishes with Center S&MA an operating plan with products, milestones, and metrics of performance effectiveness. Advocates to the AA OSMA for the needed resource shortfalls.

5.3.3 Performs process verification against agreed upon Center S&MA operating plans.

5.3.4 Serves on HEDS Assurance Board to provide input on Center S&MA process effectiveness.

5.3.5 Develops and assures conformance with program S&MA management policy and processes for human space flight, in accordance with NMI 1270.3.

5.3.6 Assures the international S&MA programs interfacing with human space flight are compatible with Agency requirements in order to enable a safe and reliable integration and space flight safety.

5.3.7 Serves as OSMA member of the Shuttle System Safety Review Panel (SSRP) and member of the ISS Safety Review Panel.

5.3.8 Serves as the Secretary to the HAB and issues agendas and schedules.

5.4 HEDS Enterprise Center S&MA Directors

5.4.1 Manage S&MA resources for the Center Director and in concert with the agreed upon operating plan as established with OSMA.

5.4.2 Measure and reports performance against agreed upon deliverables to Center Director and OSMA for both in-line and IA activities.

5.4 3 Provide program and project IA access to data required to perform the IA function. Support coordination between IA and program activities to assure correct understanding of data and management approaches.

5.4 4 Serve on the HEDS Assurance Board to provide insight into the robustness of the risk management process within the Shuttle and Station programs.

5.4.6 Participate in forums to address and resolve inter-Center S&MA issues.

5.5 Space Station Independent Assessment Manager

5.5.1 Develops Space Station IA plan and schedule and conducts structured IA program

5.5.2 As necessary, performs independent analysis of program issues uncovered by the Risk Level Screen or by direction from the HEDS Independent Assurance Director.

5.6 Space Shuttle Independent Assessment Manager

5.6.1 Develops Space Shuttle IA plan and schedule and conducts structured IA program.

5.6.2 As necessary, performs independent analysis of program issues uncovered by the Risk Level Screen or by direction from the HEDS Independent Assurance Director.

5.6.3 Manages the inter-Center PAR for the AA OSMA. As S&MA representative to the Shuttle Program, reports status at the mission FRR.

5.7 Space Shuttle S&MA TMR

5.7.1 Provides liaison for SSP Program Manager to the SFOC on S&MA effectiveness. Evaluates performance against SOW metrics.

5.7.2 Serves on HEDS Assurance Board to provide insight on SFOC operations.

5.8 Lead Center Director

5 8.1 Provides sufficient resources for S&MA as determined through discussions with OSMA and Center S&MA Directors.

5.8.2 Remains cognizant of S&MA issues associated with Center programs.

5.8.3 Supports HEDS Independent Assurance Director and independent assessment activities.

5.8.4 Evaluates Center S&MA Director performance based upon personal knowledge and input received from AA OSMA.

5.8.5 Participates in selected program reviews, as required.